Space Weather Technical Forecast

Issued on Wednesday, 08 December 2021 at 00:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of G1/Minor Storms on Days 2 and 3 (09 and 10 Dec).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity was Very Low over the past 24 hours, with just one B-class flare at 07/1905 UTC. There is currently only one sunspot region on the visible disc, AR2904, which is a small and simple region in the southeast quadrant. It has faded a little recently, now classified as Axx/Alpha. No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, was at mainly elevated levels varying around 500km/s for much of the period. It showed a gradual decline from 07/1400 UTC and is now around 420 km/s. Density has been around average, but with brief above average peaks between 07/0715-1330 UTC. The IMF, Bt, was weak at 5 nT or below and the north-south component (Bz) varied between +4/-3 nT. The phi angle was predominately positive (away from the Sun). The resultant geomagnetic activity was Quiet to Unsettled (Kp 0-3). These parameters suggest an ongoing connection to a high speed stream from CH27/28 (no longer visible on the disc).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels. The high energy electron flux (greater than 2 MeV) was at Background to Moderate levels, with a diurnal peak of 950 pfu at 07/1435 UTC. The associated 24-hour integrated fluence showed a steady decline, below the Active threshold (1e8 integrated pfu), with 3.54e7 integrated pfu observed at 08/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly Very Low, with just a Slight Chance of C-class flares from the one small and simple sunspot region on the disc, AR2904.

Solar Wind / Geomagnetic Activity: There are now two potentially Earth-directed CMEs in the forecast, with an earlier CME now considered to have missed Earth. The first CME is expected to arrive on Day 2 (09 Dec) at 1800UTC +/-9 hours, but confidence is low due to limited imagery for analysis. The second CME will likely arrive at Earth as a weak feature on Day 3 (10 Dec) around 0900 UTC +/-12hrs.
The current slightly elevated wind speeds from CH27/28 are expected to ease to background levels within the next 24 hours. A further fast wind enhancement is possible during Day 2 from CH29. Overall, there is a 20% Chance of G1/Minor Storms on Days 2 and 3 should the CMEs arrive, perhaps coinciding with the arrival of CH29s fast wind. Geomagnetic activity is expected to be mostly Quiet to Unsettled in the absence of any CME influence.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels.
The high energy electron flux (greater than 2 MeV) is likely to peak at Moderate, perhaps High levels. The associated 24-hour integrated fluence is expected to persist below the Active threshold, possibly on a slight rising trend, with a Slight Chance of rising above, mainly on Day 1

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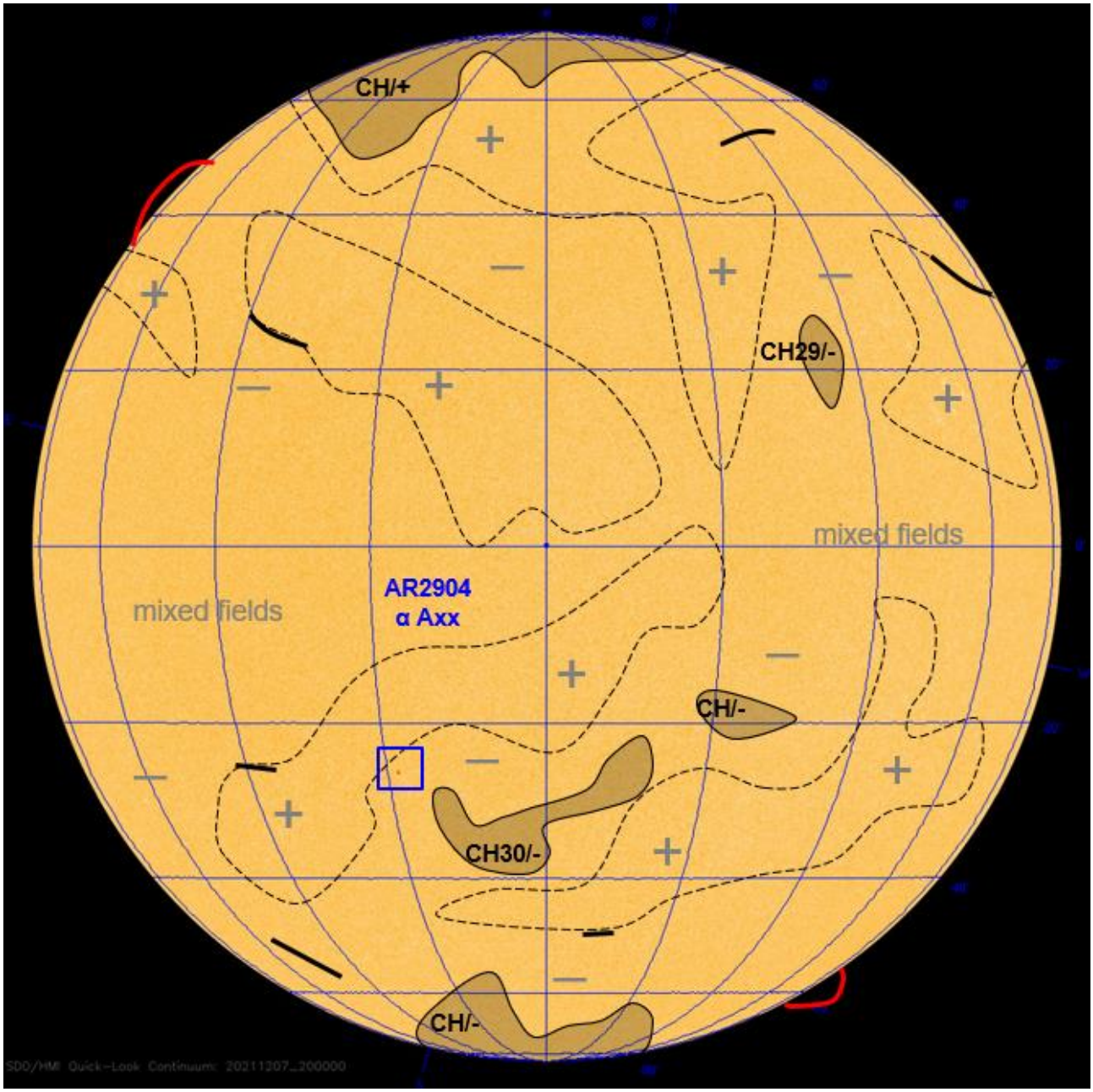
(08 Dec). Confidence is low beyond the immediate term owing to the number of (potential) transients in the forecast.

Figure 1. Solar Analysis Valid 07/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are now two potentially Earth-directed CMEs in the forecast, with an earlier CME now considered to have missed Earth.
The first CME is a faint emission from a filament eruption on 05 December, and is expected to arrive on Day 2 (09 Dec) at 1800 UTC +/-9 hours, but confidence is low due to limited imagery for analysis.
The second CME which left the Sun as a filament lift-off late on 05 December will likely arrive at Earth as a weak feature on Day 3 (10 Dec) around 0900 UTC +/-12hrs.

The current slightly elevated wind speeds from CH27/28 are expected to ease to background levels within the next 24 hours. A further fast wind enhancement is possible during Day 2 from CH29, however this feature appears to be closing up and is small and likely very weak. Overall, there is a 20% Chance of G1/Minor Storms on Days 2 and 3 should the CMEs arrive, perhaps coinciding with the arrival of CH29s fast wind.
Coronal holes of either polarity are near their semi-annual minimum potency at the minute, with Earth crossing the solar equatorial plane on Day 1 (08 Dec). As such, geomagnetic activity is expected to be mostly Quiet to Unsettled in the absence of any CME influence.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	20	20	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
06/1613 UTC	Partial	Filament eruption	SE quadrant	310 km/s	10/0900 UTC	Limited shock expected
05/2337 UTC	Partial	Filament eruption	South centre disc	325 km/s	09/1800 UTC	Limited shock expected

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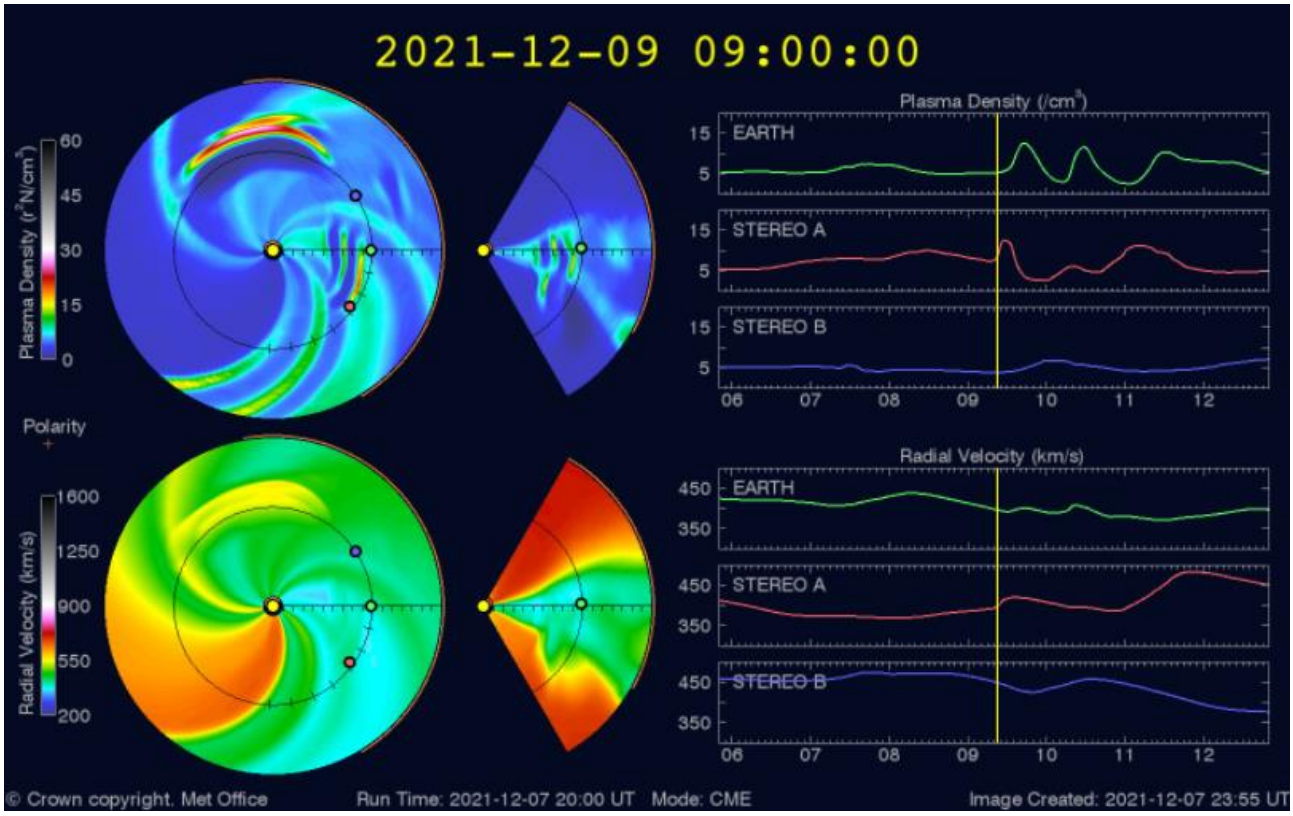
Figure 2: Enlil showing two potential CME arrivals on 09 and 10 December.



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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Solar Activity has been Very Low in the past 24 hours, with just one sunspot region on the disc, AR2904. This region has faded recently and is small and simple, classified Axx/Alpha. There is a slightly brighter region showing on STEREO-A EUVI imagery which may be a new region to rotate onto the disc on Day 3 (10 Dec) but confidence is low. Solar activity is forecast to be Low or Very Low, with only a Slight Chance (10%) of C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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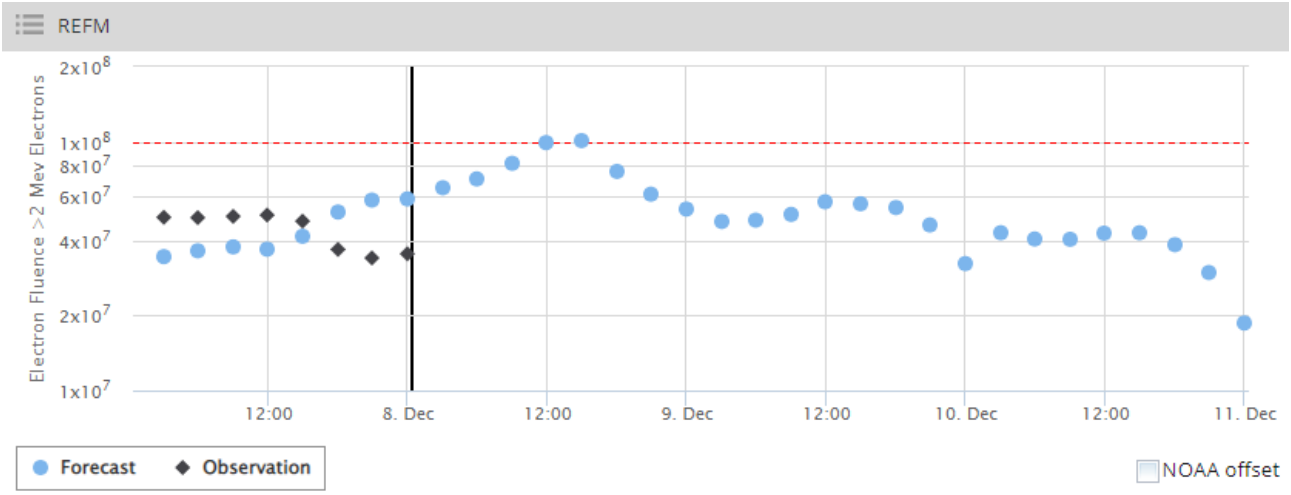
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2 MeV) as observed by GOES-16 has reached the top end of Moderate levels during the last 24 hours, and is forecast to persist near this level, with a low chance of seeing peak values increase day-to-day. There is the potential for a dropout in values from any geomagnetic activity due to CME and/or CH29 high speed stream arrival on Days 2 and 3 (09 and 10 Dec). This may be followed by an increase in values on Day 4 (11 Dec), but this is low confidence.

The associated fluence may rise slightly on Day 1 (08 Dec), but is likely to stay below Active with only a slight chance of rising above. Thereafter fluence may well drop in the wake of CME or HSS arrival, before a possible recovery on Day 4. REFM is currently suggesting a rise close to Active levels on Day 1, but this is considered to be too high with a continuation of fluence below the Active threshold most likely.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	20	10	10	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: REFM model showing a rise, which is considered likely to be too high.



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